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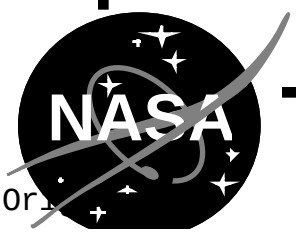
Project Implementation Plan
Volume II - Ground Data System

UNOFFICIAL

Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) and ESDIS and EOS-AM Projects

July 1996



GODDARD SPACE FLIGHT C
GREENBELT, MARYLAND

ASTER
PROJECT IMPLEMENTATION PLAN
VOLUME II - GROUND DATA SYSTEM

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CHANGE RECORD PAGE

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1. INTRODUCTION

Volume II of this Project Implementation Plan (PIP) extends the agreements between the Ministry of International Trade and Industry (MITI) of the Japanese government and the National Aeronautics and Space Administration (NASA) of the United States (U.S.) government to matters regarding the on-orbit operation and ground data processing of the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) instrument on the Earth Observing System (EOS) AM1 spacecraft. As is the case for Volume I, the terms and conditions stated in Volume II are intended to more fully define the implementation requirements and responsibilities specified in the Memorandum of Understanding (MOU) between the two parties. Consequently, this volume of the PIP addresses system interfaces and data flows between NASA's EOS Data and Information System (EOSDIS) and the MITI's ASTER Ground Data System (GDS).

This volume of the PIP will enter into force upon signature by all parties and will remain in effect until its termination, or until the termination of Volume I, by mutual agreement in accordance with provisions in the MOU and in the PIP.

For the purpose of this document, "both parties" refers to the Japanese side (represented by Earth Remote Sensing Data Resources Analysis Center (ERSDAC)) and the U.S. side (represented by the GSFC EOS AM and Earth Science Data and Information System (ESDIS) Projects).

1.1 SCOPE

This volume establishes the agreements and the respective and joint responsibilities of these agreements for the planning and implementation of on-orbit activation, flight operations, and GDS operations of the ASTER instrument on the EOS-AM1 spacecraft.

This PIP adds definition to the framework established in the ASTER MOU for NASA and MITI cooperation on the ASTER GDS. The PIP is intended to define mutual responsibilities for ASTER GDS interfaces, data flows, and technical information exchange. Specifically, this PIP addresses the ASTER data system elements comprehensively. Thus, the PIP Volume II includes consideration of ASTER mission operations, including planning and scheduling, and data transmission, handling and processing of the following data types: scientific, command and control, health and safety and other engineering data relevant to ASTER operations and data

processing. This volume also describes the Information Management System (IMS) interfaces related to the ASTER data system including user data acquisition requests, product requests, and the exchange of metadata and browse data for all standard ASTER data products.

This document emphasizes the technical implementation of agreements established in the ASTER MOU. Consequently, this volume of the PIP does not define further the matters concerning financial arrangements, release of information to the public, or liabilities of the parties in agreement. Statements in the MOU are considered sufficient for clarifying these matters.

1.2 DOCUMENT ORGANIZATION

Following introductory statements in Section 1, management matters are addressed in Section 2. Section 2 describes the U.S. and Japanese EOS program organizations and the EOS science project organization including both U.S. and ASTER science teams. The ASTER Integrated Ground System, in the context of the EOS Ground System, is discussed in Section 3. The integration ground system network interfaces are discussed in Section 4, and data and applications interfaces are discussed in Section 5. Operational concepts are described in Section 6. Documentation-related matters are discussed in Section 7.

1.3 RELATIONSHIP TO VOLUME I

This volume is being written in parallel with Volume I. Volume I focuses on the spacecraft and the instrument and Volume II focuses on the ground system.

1.4 DOCUMENT AUTHORITY

In the event of a conflict between the contents of this document and the MOU, the terms and conditions in the MOU shall take precedence.

1.5 DOCUMENT CHANGE PROCEDURE

Changes to the terms and conditions of this PIP can be initiated by either party and changed only by mutual agreement of both parties as provided for in the MOU. For purposes of considering changes to the PIP and in compliance with the procedure stated in the MOU, a Change Control Board (CCB) will be established with equal representation from both parties and chaired by NASA. The EOS Project CCB responsibility for this document is established in

accordance with the requirements of the Earth Observing System Configuration Management Plan, 420-02-02. The ASTER Project CCB responsibility for this document is established in accordance with the requirements of the document, ERSDAC AG-E-S-0004.

1.6 RESOLUTION OF DISAGREEMENTS

It is agreed that all reasonable efforts will be made by both parties to resolve any disagreements related to proposed changes to this volume. However, as provided in the MOU, should resolution not occur at the project level, it is agreed that the matter in question shall be referred to the program-level contacts for resolution.

1.7 TERMINATION

Termination of this volume of the PIP and withdrawal of support and commitment to the terms of the PIP by either party will be executed in accordance with the terms and conditions for changes, including termination and withdrawal, of the MOU. Terms for the termination or suspension of activities carried out in this volume of the PIP will be negotiated and mutually agreed to at the project level.

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2. MANAGEMENT

This section defines the organizational entities concerned with the ASTER data system: their authority, responsibilities, and objectives. Charts are included to illustrate organizational relationships.

2.1 GSFC EOS ORGANIZATION AND RESPONSIBILITIES

GSFC's project-level organization, described in Section 10 of Volume I, is included in this section to show the relationship between the EOS flight and ground system projects. The Earth Science Data and Information System (ESDIS) Project is the managing project organization for the development, procurement, implementation and operation of the EOSDIS.

The Mission to Planet Earth (MTPE) Office is responsible for the overall direction of the EOS Project at the Goddard Space Flight Center (GSFC). The Flight Projects Directorate is responsible for the management of the spaceflight projects and the Mission Operations and Data Systems Directorate is responsible for the management of the ESDIS project. The three EOS spaceflight projects, including the EOS-AM Project and the ESDIS Project, are shown organizationally in Figure 2-1. The ESDIS Project organization chart is shown in Figure 2-2.

Responsibility for specific ASTER implementations have been assigned to EOS Project staff as follows. The ASTER Instrument Manager in the EOS-AM Project has the primary responsibility for all issues related to the ASTER instrument. The Science Data and External Interface Manager in the ESDIS Project is the primary point of contact for all issues related to the ASTER integrated data system.

The ASTER Instrument Manager and the Science Data and External Interface Manager share the responsibility for conducting all NASA negotiations leading to the execution of the ASTER PIP Volume II, and for negotiating changes to Volume II.

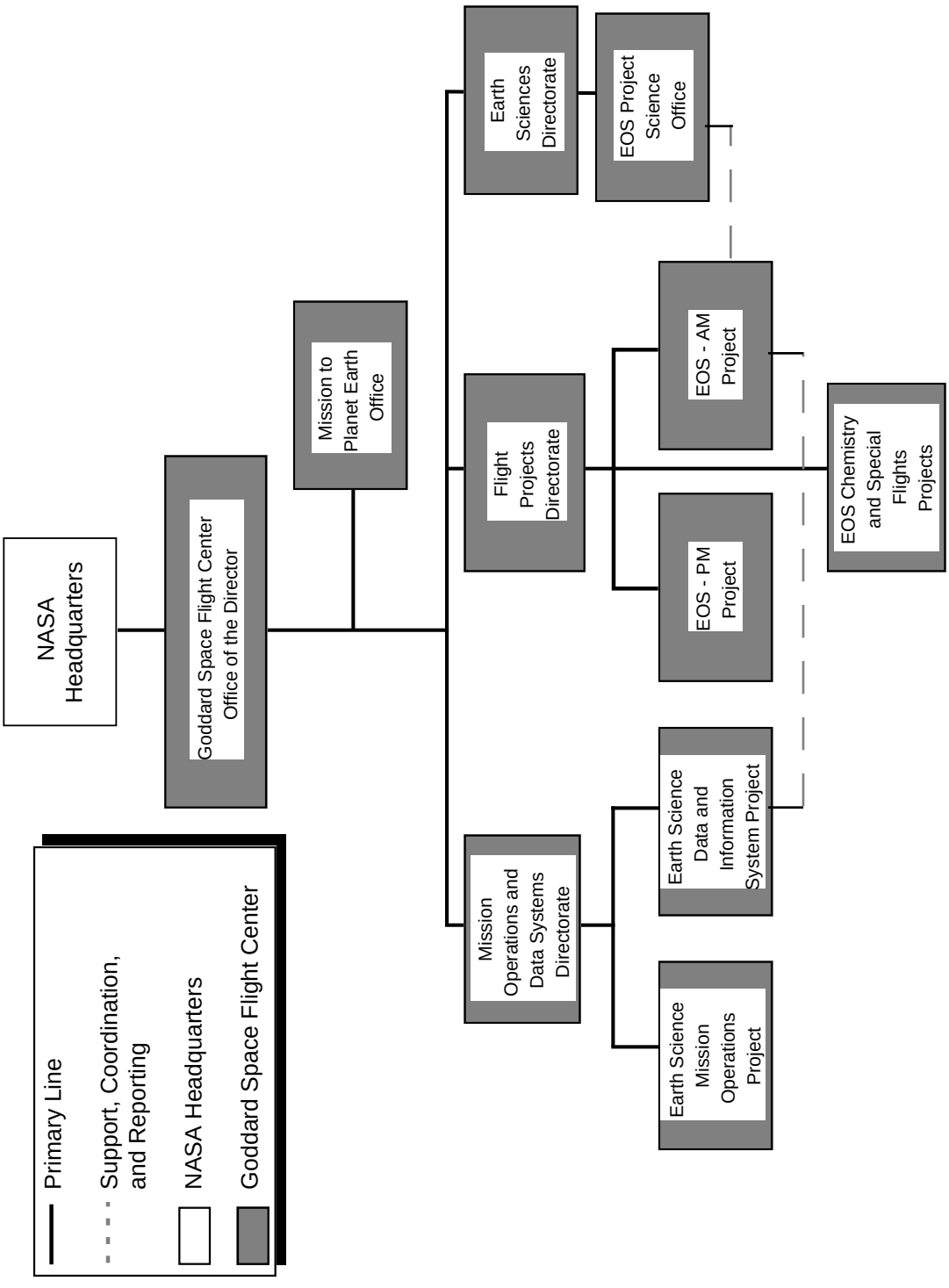

Figure 2-1. GSFC EOS Program Organization

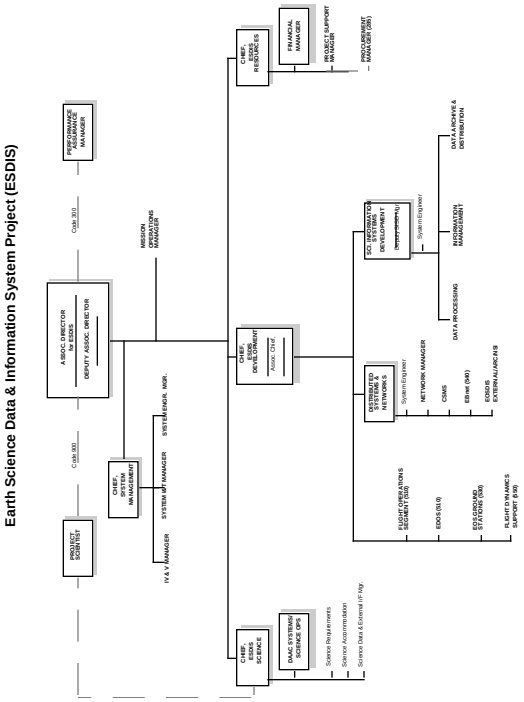

Figure 2-2. ESDIS Project Organization

2.2 JAPANESE EOS PROGRAM ORGANIZATION AND RESPONSIBILITIES

2.2.1 Organizational Overview

The ASTER program organization is shown in Figure 2-3. The Space Industry Division (SID) of the MITI is responsible for overall direction, management, and evaluation of the ASTER program. The MITI's responsibilities for this program are assigned to the director of the SID. The director of the SID designates a program manager for managing all ASTER activities.

MITI has two organizations, the Japan Resources Observation System (JAROS) organization and the Earth Remote Sensing Data Analysis Center (ERSDAC) for the ASTER project implementation. MITI entrusts the ASTER instrument project to the JAROS, which includes design, development, procurement, testing, and delivery of the ASTER instrument. MITI entrusts the ASTER GDS Project to ERSDAC, which includes design, development, procurement, testing, and operation **(TBR)** of the ASTER GDS, and delivery of ASTER data.

2.2.2 ERSDAC Organization and Responsibilities

MITI entrusted the ASTER GDS development to ERSDAC supported by JAROS in the ASTER program. The ERSDAC Managing Director established a dedicated ASTER project, and also nominated: an ASTER Science Project Manager, an ASTER GDS Project Manager, and an ASTER GDS Liaison Officer.

The responsibilities of the ASTER Science Project Manager are to:

- Manage activities of the Japanese members of the ASTER Science Team.
- Manage implementation of the science version of algorithms for the standard data products for which Japan is responsible, and to supply them to ASTER GDS.
- Request data acquisition plan to ASTER GDS which is developed by ASTER Science Team.
- Manage the ASTER calibration, validation and scientific verification activities for standard products for which Japan is responsible.

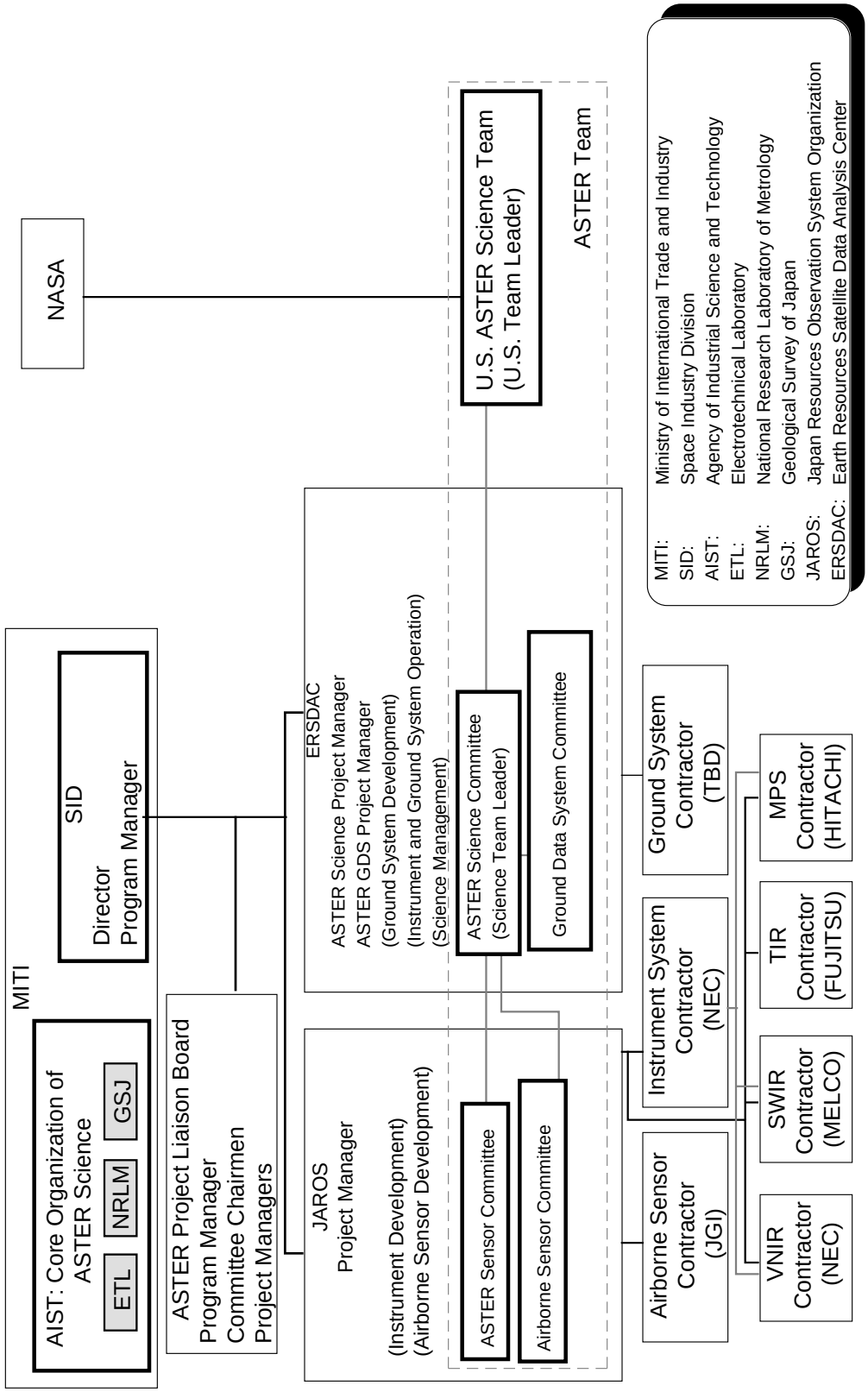

Figure 2-3. ASTER Program Organization

The responsibilities of the ASTER GDS Project Manager are to:

- Design the ASTER GDS.
- Develop ASTER GDS version of software for standard data products for which Japan is responsible.
- Define the procedure and to develop the software for the operation of the ASTER instrument and the ASTER GDS.
- Communicate to the ESDIS and EOS AM projects as an ERSDAC point-of-contact.
- Attend and/or support the data system reviews and interface meetings conducted by the ESDIS and EOS AM projects that relate to or affect the ASTER GDS.
- Coordinate and/or support MITI activities agreed to in the ASTER Project Implementation Plan (Vol. II).
- Support all other ASTER-related MITI activities in the U.S.

The ERSDAC organization for ASTER is shown in Figure 2-4. In order to promote the ASTER GDS development and related operations, individual personnel within ERSDAC have their own responsibilities for the ASTER GDS and related operations and should control their own contractors.

The ASTER Science Committee and ASTER GDS Committee are organized as advisory bodies to the Managing Director. The ASTER Science Committee acts as the ASTER Science Team in Japan, and is responsible for interfacing with the ASTER Science Team in the U.S. to maintain close cooperation between Japanese and U.S. scientists. The ASTER GDS Committee is responsible for interfacing with the ASTER Science Committee to exchange information on the ASTER data necessary for science activities.

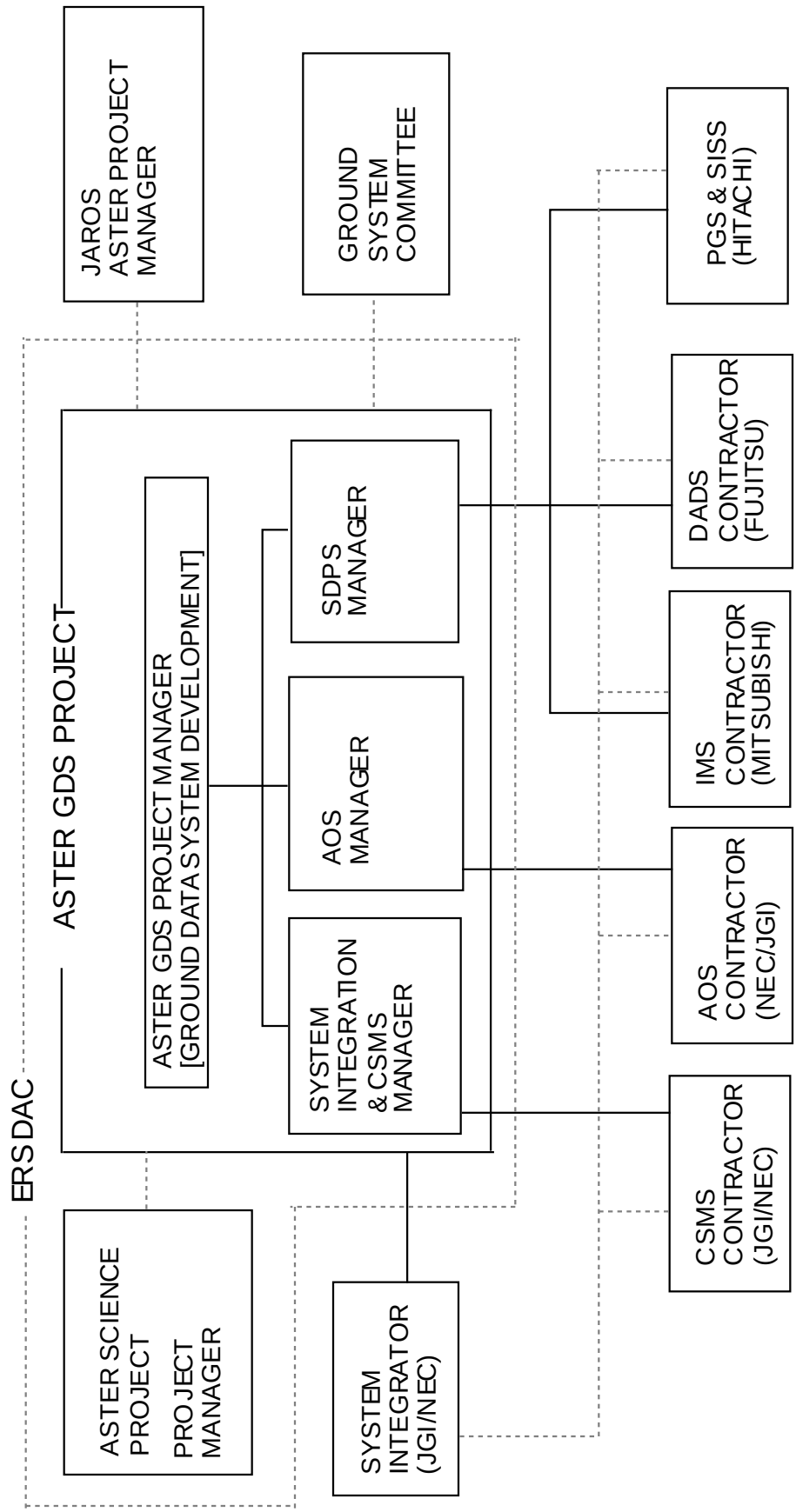

Figure 2-4. Organization of ASTER GDS Project

2.2.3 JAROS Organization and Responsibilities

MITI entrusted the ASTER instrument development to JAROS in the ASTER program. JAROS Managing Director established a dedicated ASTER project and nominated an ASTER instrument project manager. This ASTER instrument project manager, within JAROS and dedicated to the ASTER instrument, will provide the coordinating leadership in the implementation of the ASTER development, interface plans, technical guidance, and other related matters. The JAROS organization for ASTER is shown in Figure 2-5. In order to promote the ASTER development, individual personnel within JAROS have their own responsibilities for the ASTER subsystems respectively, and should control their own contractors.

An ASTER operations manager is responsible for the interface between the ASTER instrument and the ASTER Integrated Ground System.

An ASTER task manager is responsible for the budgetary aspect of the ASTER instrument and the logistics as well as other tasks such as a license and schedule control.

The ASTER Sensor Committee and the Airborne Sensor Committee are organized as advisory bodies to the Managing Director. These Committees are responsible for interfacing with the ASTER Science Committee in ERSDAC to exchange information on the ASTER instrument performance necessary for science activities.

2.3 EOS SCIENCE ORGANIZATION

The EOS science organization is made up of the Investigator Working Group (IWG), Project Scientists associated with each EOS project, and the various interdisciplinary and instrument teams.

Investigator Working Group (IWG). The IWG is made up of all the NASA-selected EOS Interdisciplinary Principal Investigators and Co-Investigators, Instrument Principal Investigators and Co-investigators, and Facility Instrument Team Leaders. The IWG sets and approves the scientific objectives for the overall EOS Project. With regard to ASTER, it confirms and endorses the ASTER scientific priorities, including standard data products (see Section 6.3).

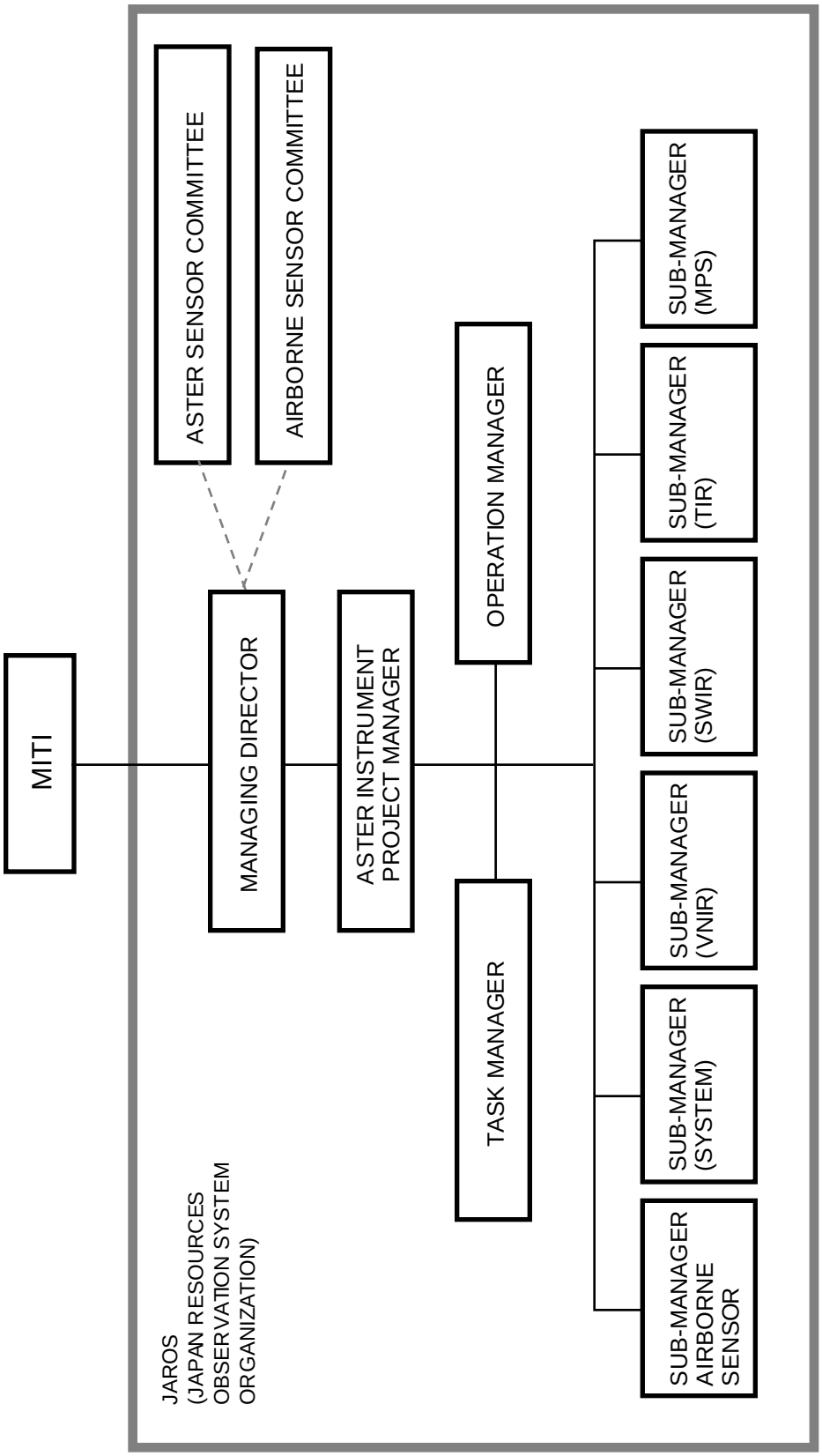

Figure 2-5. JAROS Organization for ASTER

EOS AM Project Scientist. The EOS AM Project Scientist, or his designee, will evaluate scientific requirements placed on the AM Project, and functional capability of the ASTER Integrated Ground System, to ensure that the system meets the requirements of scientific users. He will have responsibility for approving guidelines related to ASTER instrument activity requests (XARs, see Section 6.4 for the definition of XAR) as established by the ASTER Science Team, and has final authority for resolving science related conflicts that arise during planning and scheduling of ASTER operations. The EOS AM Project Scientist will conduct a peer review of all ASTER standard data product algorithms.

ASTER Science Team. The ASTER Science Team consists of both Japanese and U.S. members. This team conducts research related to the development of algorithms for generating data products from the ASTER instrument, and the application of these derived data products in MTPE studies. The team also provides science guidance to both the flight and ground system developers to ensure that flight and ground elements are developed to meet the overall ASTER science objectives.

The ASTER Science Team is responsible for developing a common set of algorithms for ASTER standard data products to be generated both in Japan and in the U.S. The team shall have access to all pre-launch calibration and other related data to develop the radiometric and geometric calibration algorithms required to produce the Level 1 standard products. It will also be responsible for defining the characteristics and descriptions of the browse files for the Level 1 standard products (see Sections 5.1 and 6.3). In addition to the development of algorithms, the team will plan and conduct field activities to calibrate, characterize, and validate ASTER standard data products.

The ASTER Science Team will develop guidelines for ASTER data acquisition to be reviewed and approved by the EOS AM Project Scientist in consultation with the IWG. The guidelines will specifically address how resources are to be allocated among ASTER science team members and other users. This approved set of guidelines will be used by the team and the ASTER GDS for planning and scheduling ASTER instrument operations.

The U.S. ASTER Science Team members are responsible for developing and validating the algorithms and their related software to generate those Level 2 and higher standard data products that are produced in the U.S. In addition, they are responsible for the

scientific verification of these standard data products. They are also responsible for generating special data products.

The Japanese ASTER Science Team members are responsible for developing and validating the algorithms for generating Level 1 standard products. They are responsible for developing and validating algorithms for generating Level 2 and higher standard products that are produced in Japan. They are also responsible for generating algorithms for special data products.

The Japanese ASTER Science Team members have the primary responsibility for the ASTER instrument calibration and characterization, both pre-launch and on-orbit, with inputs from the U.S. team members.

The ASTER Science Team leader has the final responsibility for the ASTER instrument operating schedule in the ASTER ICC.

2.4 REVIEWS AND MEETING SUPPORT

ERSDAC and GSFC shall support reviews, meetings, and activities, such as interface design reviews, ASTER GDS/EOSDIS interface meetings and other meetings and activities as mutually agreed. ERSDAC, together with the ASTER Science Team, will participate in the algorithm peer reviews conducted by the EOS Project Science Office.

2.5 CONFIGURATION MANAGEMENT

Each party will manage its Configuration Management (CM) program in adherence to its own configuration management plan. CM requirements are defined in the ERSDAC Configuration Management Plan, document number AG-E-S-0004 in Section 5.0 of the ASTER Nine Plans, 90JS-POP-TS0-10; and in the GSFC EOS Project document, Earth Observing System Configuration Management Plan, 420-02-02.

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3. ASTER INTEGRATED GROUND SYSTEM

The end-to-end data system for ASTER includes elements provided by both the U.S. and Japan. To differentiate among the various ground system elements having very similar names, the following nomenclature is used in this PIP. The term ASTER Integrated Ground System is used to refer to the overall integrated U.S. and Japanese ground system elements which affect the acquisition and processing of ASTER data. The overall entity managed by GSFC is referred to as the EOS Ground System. Those segments or elements or components being developed, procured, and placed into operation by GSFC's ESDIS Project are referred to as EOSDIS. Those segments provided by ERSDAC are referred to as the ASTER GDS.

3.1 U.S. ELEMENTS OF THE ASTER INTEGRATED GROUND SYSTEM

This section provides an overview of the EOS Ground System, detailed descriptions of the EOSDIS elements related to the ASTER data system, and the system operations concept.

3.1.1 EOS Ground System Overview

The major components of EOSDIS are described in this section and illustrated in Figure 3-1. These components include Networks, Scientific Computing Facilities (SCFs), Distributed Active Archive Centers (DAACs), EOSDIS Core System (ECS), and EOS Data and Operations System (EDOS).

3.1.1.1 Networks

The EOSDIS Backbone Network (EBnet) provides wide-area communications circuits and facilities between and among various EOS Ground System (EGS) elements to support mission operations and to transport mission data between EOSDIS elements. EBnet is responsible for transporting spacecraft command, control, and science data nationwide on a continuous basis, 24 hours a day, 7 days a week. The EBnet real-time service transports mission-critical data related to the health and safety of on-orbit space systems and raw science telemetry. EBnet provides a highly redundant network with an operational availability of .9998 and a Mean Time to Restore Service (MTTRS) of one minute for transporting real-time mission-critical data.

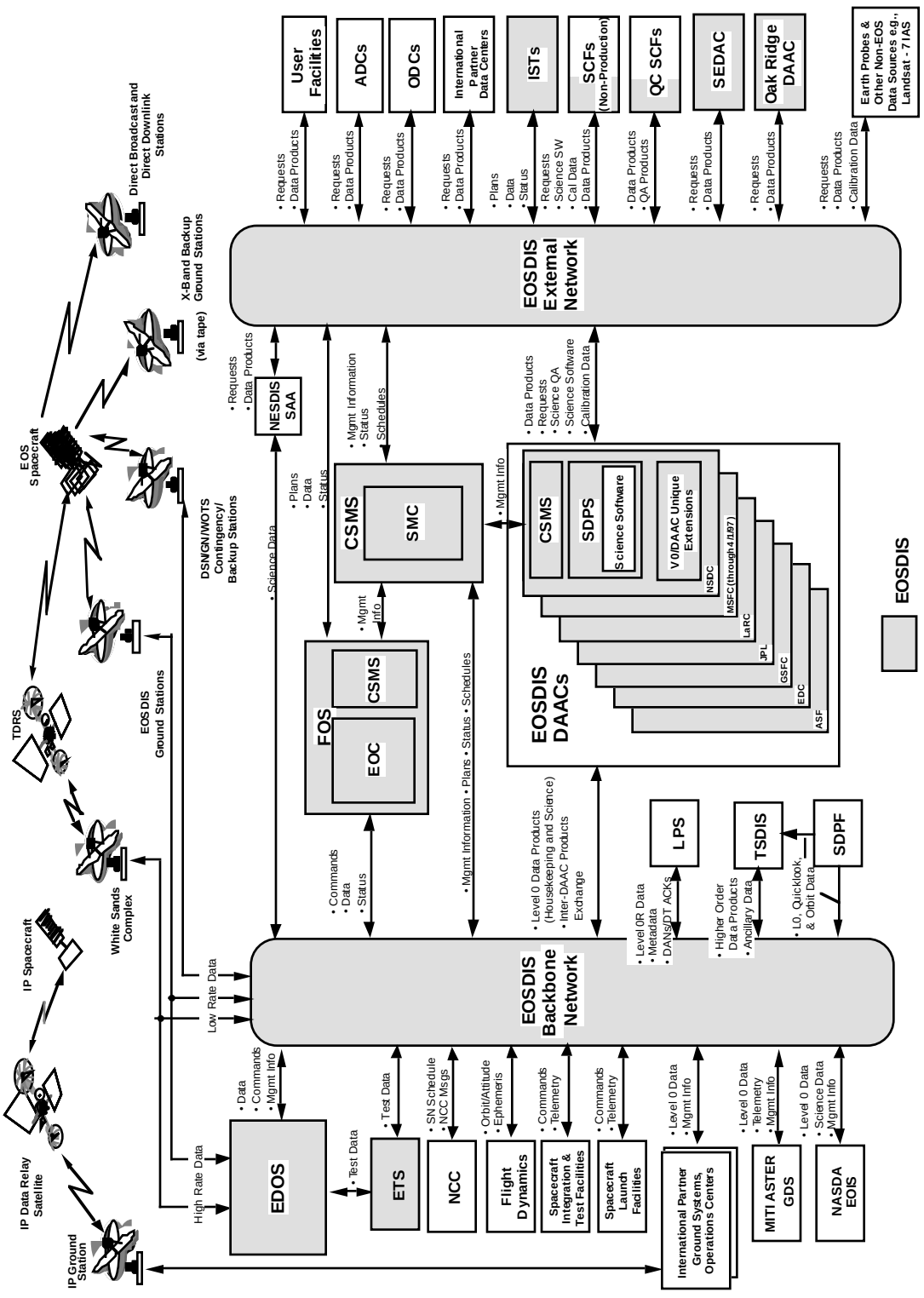

Figure 3-1. EOS Ground System

EBnet also transports various levels of processed science data, including expedited data sets and production data sets. The operational availability for this service is .98 with a MTTRS of 4 hours.

3.1.1.2 Scientific Computing Facilities (SCFs)

The computing facilities used by the EOS investigators (Facility Instrument Team Leaders and Team Members, Instrument Principal Investigators, and Interdisciplinary Investigators) are called SCFs. These facilities range from individual workstations to supercomputers. They are used for development of algorithms and models for the generation of standard and special products, accessing the services provided by EOSDIS, and a variety of other uses.

U.S. ASTER Instrument Support Terminal (IST). The U.S. ASTER IST resides at the SCF of the U.S. Team Leader of the ASTER Science Team. The U.S. ASTER IST provides mechanisms for evaluating the agreement between the XAR schedule and ASTER science goals, for performing studies to determine the effect of changing guidelines on the ASTER schedule, and for communicating with Japanese members of the ASTER Science Team via the Japan ASTER IST on the ASTER schedule.

3.1.1.3 Distributed Active Archive Centers (DAACs)

DAACs provide reliable and operationally robust services to global change researchers whose needs cross traditional discipline boundaries, while continuing to support the particular needs of their respective discipline communities. The DAACs provide their services to the user community using capabilities developed as a part of the Science Data Processing Segment (SDPS) of the ECS and may develop unique capabilities to augment them. The EDC DAAC will have the responsibility for higher level ASTER product generation, archive, and distribution in the U.S.

3.1.1.4 EOSDIS Core System (ECS)

The ECS provides the "core" common capabilities and infrastructure required for performing planning and scheduling, command and control, product generation, information management, data archiving and distribution, and user access to data held by EOSDIS. The ECS consists of three segments: SDPS, Communications and System Management Segment (CSMS), and Flight Operations Segment (FOS).

SDPS. The SDPS supports product generation, data archiving and distribution, and information management. The hardware and software, developed as a part of ECS, will reside and operate at the DAACs. It supports the integration and testing of software for product generation algorithms developed by the EOS investigators. It provides for planning of data product generation taking into account interdependencies among them, and the distribution of computational resources. It provides for ingest and storage (temporary or permanent, depending on data type) of data sets needed from other data centers for supporting the generation of standard data products. It generates standard products in a timely manner using the investigators' algorithmic software. It supports the extraction of appropriate subsets of standard data products to assist in scientific quality control by the respective investigators. It supports reprocessing as required. It stores data in organized collections of related data including related observations, data products, associated documents and other information to facilitate their access by users. It supports a variety of search and access capabilities. It provides toolkits for use by EOS investigators to support development of product generation algorithms. It provides the Applications Program Interfaces (APIs) and software components to permit migration of subsets of its capabilities to SCFs and other facilities which may provide data access and other services to the user community. It provides an infrastructure to ensure interoperability among DAACs and enables interoperability with SCFs and other facilities. The SDPS will also perform the functions required for constructing user Data Acquisition Requests (DARs) for ASTER, and for forwarding DARs to Japan. The SDPS will obtain DAR schedule information from the ASTER GDS IMS, and will provide information to users on DAR status.

CSMS. The CSMS provides the communications, networking and system management functions needed by the SDPS and FOS. It provides the capabilities for the DAACs to perform local system management functions and the capabilities for cross-DAAC coordination and monitoring to ensure autonomous, yet coordinated operation of SDPS. It provides for monitoring and maintaining status information about all of EOSDIS. It provides common services such as object request brokering, client/server communications, electronic mail, bulletin boards, local area and wide area networks, system security, accounting, user registration, and report generation._

FOS. The FOS controls all the EOS spacecraft, provides mission planning and scheduling, and monitors health and safety of the spacecraft and instruments. It provides tools to coordinate observations from multiple instruments and develop conflict-free schedules, validate commands to assure safety, accommodate unplanned schedule changes, develop and provide mission timeline, and develop and implement contingency plans. It interacts with the various elements of the ground systems and space network as necessary to send commands to the EOS spacecraft and to receive health and safety data from those spacecraft. Communications for EOS spacecraft and all instrument commands will go through the EOS Operations Center (EOC), which coordinates with external systems such as the ASTER Instrument Control Center (ICC). The EOC also will monitor the health and safety of the ASTER instrument in support of the ASTER ICC. The EOC is located at GSFC.

3.1.1.5 EOS Data and Operations System (EDOS)_

EDOS transmits commands to the EOS spacecraft, captures science and engineering data from the spacecraft and instruments, processes telemetry to generate Level 0 products, and maintains a backup archive of Level 0 products. It removes telemetry artifacts, creates sets of non-overlapping raw data as sensed by the individual instruments over specific time intervals. Level 0 data are sent from EDOS to the appropriate DAACs and to the ASTER GDS for generation of higher level products. The EDOS also provides a long-term backup archive of the Level 0 processed data; these data are available for distribution by special arrangement.

3.2 JAPANESE ELEMENTS OF THE ASTER INTEGRATED GROUND SYSTEM

This section provides an overview of the ASTER GDS, a detailed description of the ASTER GDS elements, and the system operation concept.

3.2.1 ASTER Ground Data System Overview

ASTER GDS has been defined as a hierarchy of segments, subsystems, and components. Three ASTER GDS segments are defined to support three major operational areas: the ASTER Operation Segment (AOS), the Communication and System Management Segment (CSMS), and the Science Data Processing Segment (SDPS). The segments are further divided into ASTER GDS functional elements to provide the support required by the operational segments. Figure 3-3 illustrates the ASTER GDS; its major elements are described briefly below.

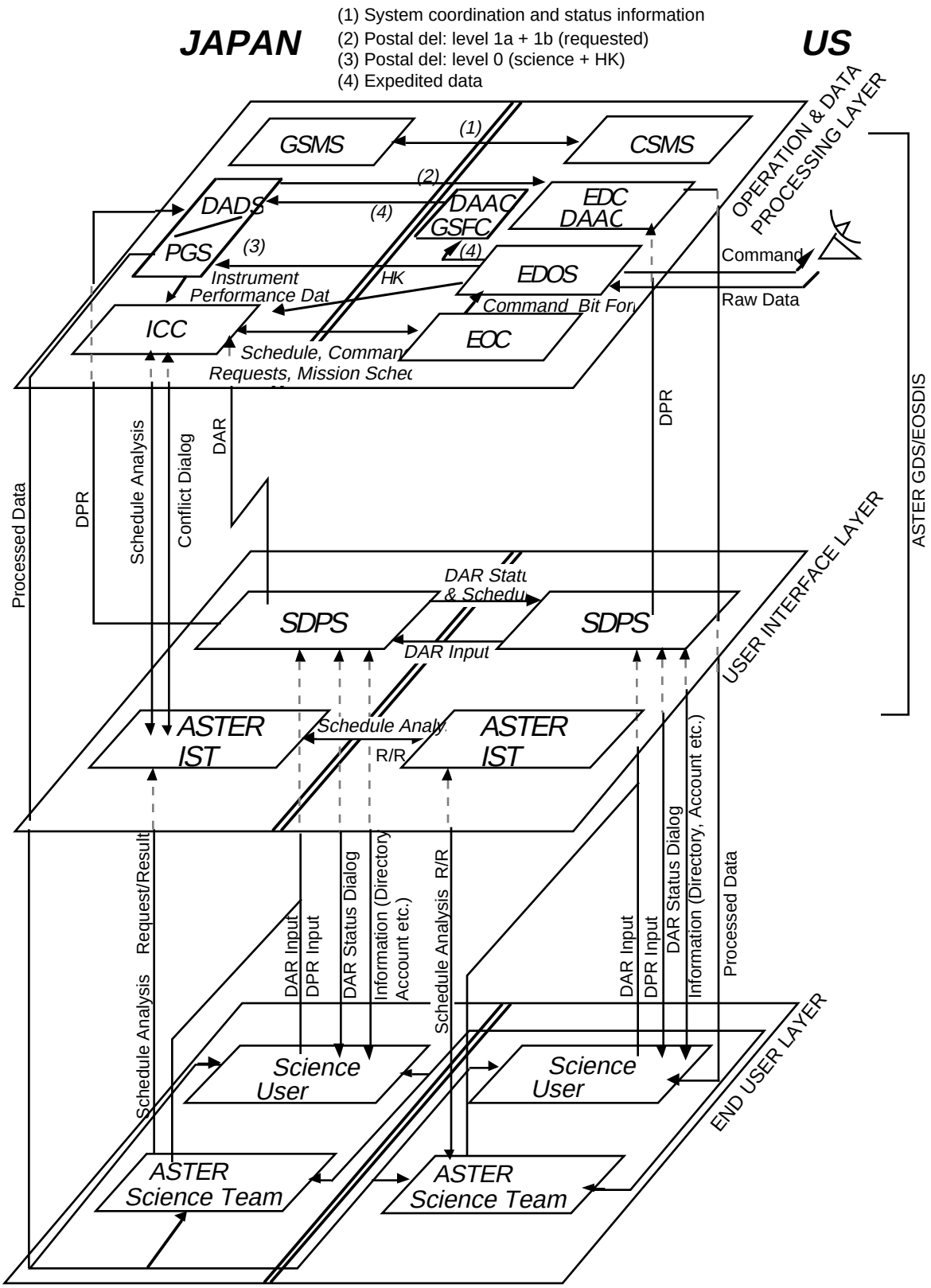

Figure 3-2. ASTER Operations Concept (Summary)

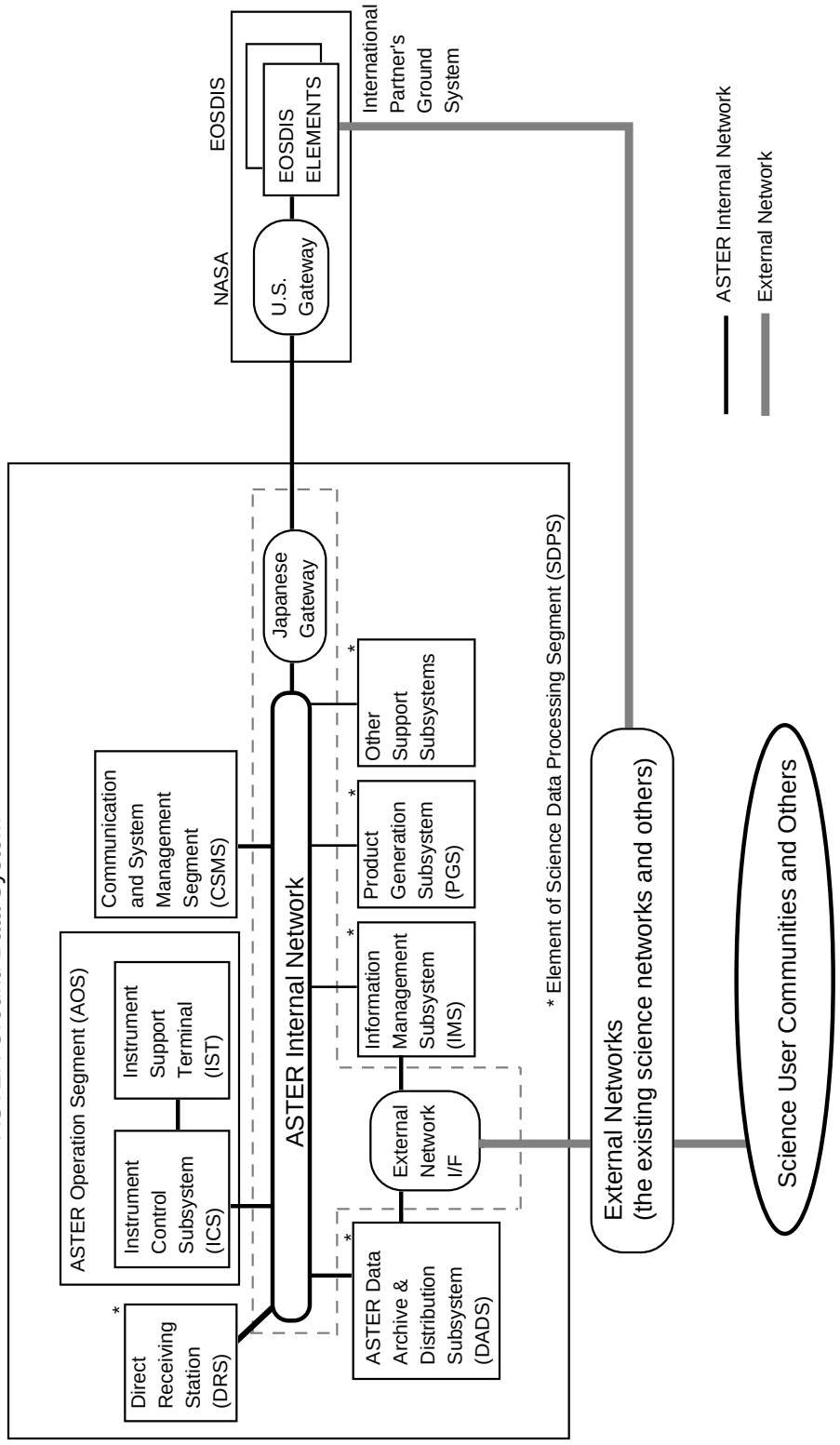

Figure 3-3. ASTER Ground Data System Architecture Concept

3.2.1.1 The ASTER Operations Segment

The AOS manages ASTER instrument operations and controls the ASTER instrument through EOC. The AOS elements are the Instrument Control Center (ICC), including the Instrument Control Operation Subsystem and the Instrument Analysis Support Subsystem, and the Instrument Support Terminal (IST). The ICC is responsible for the operations of the ASTER instrument. It performs planning, scheduling, commanding (via EOSDIS), and monitoring. The IST is defined as a facility that connects the ASTER Science Team leader to the ICC in support of instrument operation.

3.2.1.2 The Communications and System Management Segment

The CSMS provides system resource management, communications services, and security services. The CSMS includes the GSMS, and the ASTER Data Network (ADN).

3.2.1.3 The Science Data Processing Segment

The SDPS provides a set of processing and distribution elements for ASTER science data, and a software implementation system for the entire Product Generation Subsystem (PGS). The SDPS elements include the PGS consisting of the Data Processing Subsystem (DPS) and the Data Analysis Subsystem (DAS), the Information Management Subsystem (IMS), the ASTER Data Archive and Distribution Subsystem (DADS), and the Software Implementation Support Subsystem (SISS).

The PGS and DADS facilities process the data from Level-0 data up to standard higher data products, provide short- and long- term storage for the ASTER project, and distribute the data to users. The IMS provides a data and information management service including a catalog system in support of user data selection and ordering. The SISS provides an environment for the scientists to develop the product generation software.

3.2.1.4 Direct Receiving Station

As described in Section 6.2, Direct Down Link is planned and ASTER GDS will include a Direct Receiving Station which will be capable of receiving ASTER data directly from EOS-AM1 by using X-band data transmission. ASTER GDS will also have a Level 0 processing capability.

3.2.2 ASTER Ground Data System Elements of the ASTER Integrated Ground System

The specific ASTER GDS elements are illustrated, along with their interfaces, in Figures 3-2 and 3-3. Descriptions of these elements are provided below.

3.2.2.1 The ASTER Data Archive and Distribution Subsystem

The ASTER DADS is responsible for archiving and distributing ASTER data. This includes Level-1a and -1b and higher level data products, ancillary and correlative data, metadata, browse data, command histories, algorithms, and documentation. The data will be distributed from the ASTER DADS to the EDC DAAC, and individual users.

3.2.2.2 The ASTER Instrument Control Center

The ASTER ICC plans and schedules instrument operations, generates and validates command sequences, monitors the health and safety of the ASTER instrument, and provides Japan's IST and Japan's IMS with ASTER instrument and EOS-AM1 spacecraft status information.

3.2.2.3 The Japan Information Management Subsystem

The Japan IMS is the user interface for the ASTER GDS and the EOSDIS. The IMS provides information about data archived in ASTER GDS and EOSDIS archives, on a 24-hour basis; accepts user orders for ASTER data; provides information about future data acquisition and processing schedules; accepts and forwards data acquisition and product requests; and maintains information on system status, management, and coordination. Users accessing the U.S. IMS from Japan's ASTER IMS will see the same comprehensive "Earth science" view of the overall EOSDIS database. The IMS will also perform the functions required for constructing user DARs for ASTER and other instruments, forwarding the ASTER DAR status and schedule, and the non-ASTER DARs to the U.S. IMS. The IMS will obtain DAR status and schedule information concerning other instruments from the U.S. IMS, and will provide DAR status information to users.

3.2.2.4 The Japan Instrument Support Terminal (IST)

The Japan ASTER IST provides mechanisms for evaluating the agreement between the DAR schedule and ASTER science goals, for performing studies to determine the effect of changing guidelines on the ASTER schedule, and for communicating with U.S. members of

the ASTER Science Team via the U.S. ASTER IST in developing the ASTER schedule. The Japan IST has the capability to monitor the ASTER instrument and the EOS-AM1 spacecraft status information. The Japan IST provides the U.S. IST with instrument and EOS-AM1 spacecraft status information.

3.2.2.5 The Ground System Management Subsystem

The GSMS provides system management services in coordination with other ASTER GDS segments and subsystems, yielding a "system-wide view" of ASTER GDS operations. GSMS services include schedule coordination, status monitoring, performance and configuration management, fault and security management, user authorization, and accounting. GSMS exchanges management and status information with the U.S. SMC for the purpose of coordinating ground operations.

3.2.2.6 ASTER Data Network

The ADN provides an internal network for communications among the ASTER GDS elements, a network interface to the internet, a network interface to the EBnet, network security services, and a network management facility.

3.2.2.7 The Japan ASTER Product Generation Subsystem

The PGS performs data processing functions, such as Level-1 and standard higher products, metadata, and browse data sets.

3.2.2.8 The Software Implementation Support Subsystem

The SISS supports scientists to develop the algorithm/software, performs the calibration/validation and generates special products.

4. ASTER INTEGRATED GROUND SYSTEM NETWORK INTERFACES

Coordinated functioning of the ASTER data system requires mechanisms for exchange of data among system elements. Of particular interest is the bilateral data exchange between U.S. and Japan system elements. The operations concept for the ASTER Integrated Ground System (IGS) calls for international data exchange via electronic networks and via postal delivery. In the case of electronic networks, there is a network interface between ASTER GDS and EOSDIS that is provided by ADN and EBnet. Trans-Pacific network circuits will be provided by EBnet, via a reimbursable arrangement between GSFC and ERSDAC for shared costs of the trans-Pacific circuit and related expenses as mutually agreed. The basic principle to be applied for the financial responsibilities of network connection is the agency with the requirement for the data and information is responsible for the connection. Such responsibilities are summarized in Table 4-1. Details of the trans-Pacific network linkages for the ASTER IGS are to be determined by mutual agreement between ERSDAC and NASA/GSFC.

Table 4-1. Trans-Pacific Network Linkages

Connection (Descriptions are from end-to-end, but actual trans-Pacific linkage is between the U.S. gateway and the Japanese gateway.)	Responsible Party
EDOS to ASTER ICC (real time and playback telemetry, etc.)	ERSDAC
Expedited Data Sets requested by Japan from EOSDIS to ASTER GDS (2 scenes/day)	ERSDAC
EOC to ICC (scheduling data, command status, mission status)	ERSDAC
ICC to EOC (instrument schedule data, instrument status, etc.)	ERSDAC
ICC to EOC (EOS Project Scientist for DAR and TOO conflict, TOO request)	GSFC
EOC to ICC (DAR and TOO conflict resolution, etc.)	ERSDAC
U.S. SMC to GSMS (management and status information)	ERSDAC
GSMS to U.S. SMC (management and status information)	GSFC
U.S. ASTER IST to Japan's IST (schedule analysis requests)	GSFC
Japan's IST to U.S. ASTER IST (schedule analysis results)	GSFC
EOSDIS User (Client) 2-way Message Traffic with ASTER GDS	GSFC
ASTER GDS User (Client) 2-way Message Traffic with EOSDIS	ERSDAC

5. ASTER DATA AND APPLICATIONS INTERFACES

ERSDAC and GSFC have the goal of improving interoperability between their ground data systems, and software exchange is one means for reaching this goal. This section defines the general terms for software re-use. This section also identifies the specific software exchanges that ERSDAC and GSFC have agreed to, along with the project responsibilities, terms and conditions for each case. The software exchanges between GSFC and ERSDAC are summarized in Table 5-1.

Unless otherwise stated, it is understood that the responsibilities outlined in this section (including responsibilities for software maintenance) extend for the life of the EOS-AM1 mission. As defined by the MOU, “The duration of the EOS-AM1 program is for the actual life of the EOS-AM1 spacecraft plus an additional ten years, after flight, for continuing EOS-AM1 data management responsibilities.”

Unless otherwise stated, it is understood that the software donor identified in the sections below (either ERSDAC or GSFC) will provide software and maintenance (such as upgrades) free of charge to the recipient (again, either ERSDAC or GSFC). The software recipient is responsible for ensuring that the donor’s conditions listed in each section are met.

In the software exchanges outlined below, it is understood that the software donor will from time-to-time make changes in the software provided to the recipient. It is agreed that the software donor will notify the recipient of proposed changes in donated software. Following this notification, the software recipient will inform the donor of any cost, risk or schedule impact that may result from the proposed changes.

5.1 DATA PRODUCT GENERATION SOFTWARE EXCHANGE

This section defines responsibilities for data product generation software exchange: Level 1a and 1b data product generation software provided by ERSDAC and Level 2 and higher level data product generation software provided by GSFC.

Table 5-1
Summary of Software Exchange Between GSFC and ERSDAC

software type	source	executable	remarks
ERSDAC Level 1a/1b Product Generation Software	√		beta, engineering & launch versions
ERSDAC IST	√	√	executable for ERSDAC-selected platforms
ERSDAC DAR	√		
GSFC EOS Standard Product Generation Software	√		
GSFC EOSDIS V0 IMS Client	√		
GSFC EOSDIS V0 IMS Server	√		
GSFC EOSDIS V1 IMS Client		√	
GSFC EOSDIS V0/V1 Gateway	√		
GSFC EOSDIS IST		√	
GSFC EOSDIS SDP Toolkit	√		

5.1.1 ERSDAC Product Generation Software

ERSDAC has the responsibility for generating and maintaining ASTER Level 1a and 1b science data product generation software, based on the algorithm provided by the Japanese members of the ERSDAC's ASTER Science Team. In this regard, ASTER Science Project, in collaboration with the ASTER Science Team, will prepare an Algorithm Theoretical Basis Document (ATBD) providing the theoretical basis for ASTER Level 1a and 1b algorithms. This ATBD will be approved by the EOS Project Science Office (PSO).

ERSDAC will deliver to GSFC ASTER Level 1a and 1b data product generation software that incorporates the mandatory parts of the SCF version of the SDP Toolkit as documented in the ECS PGS Toolkit Requirements Specification, Document No. 423-16-02 (see Section 5.5). This software will conform to the system constraints and standards identified in the Data Production Software and SCF Standards and Guidelines, Document No. 423-16-01. ERSDAC will define, in collaboration with the ASTER Science Team, additional specific terms for the content and format of the Level 1a and 1b data products, and the data product generation software delivery schedule.

At present, the mandatory parts of the SCF Toolkit are completely disclosed. If the functions of the mandatory parts of the Toolkit do not meet the ASTER GDS science software development requirements, then ERSDAC will take prompt action to report its functional requirements to ESDIS. ESDIS and ERSDAC will negotiate solutions, which may include changes to the Toolkit, changes in the ERSDAC science software, or waiver of the ESDIS requirements on the use of the Toolkit.

The following conditions also apply:

a. ERSDAC shall provide the ASTER Level 1a and 1b software and documentation to GSFC.

b. ERSDAC shall provide GSFC with ASTER Level 1a and 1b software and documentation upgrades as they become available.

c. ERSDAC shall provide support to resolve integration problems jointly with GSFC.

d. ERSDAC shall be responsible for the development and maintenance of ASTER Level 1a and 1b software that generates metadata and browse data.

e. ERSDAC, together with the ASTER Science Team, shall monitor on-orbit calibration over the life of the ASTER instrument and shall incorporate needed changes into the software and/or databases required for Level 1 processing.

f. ERSDAC shall archive correlative or ground-truth observations made in support of ASTER, and shall make these data available to EOSDIS.

g. ERSDAC shall provide a software and data management plan that includes enough information to use the software, the specific contents of which are to be mutually agreed.

h. GSFC shall provide ASTER Level 0 data suitable for interface testing.

i. ERSDAC shall provide simulated ASTER Level 1a and 1b data sets suitable for the purpose of interface testing. The schedule for delivery shall be mutually agreed by both parties.

j. ERSDAC shall deliver ASTER Level 1a and 1b software as follows: Beta Version, Engineering Version, Launch Version, and Updated Versions (as defined below). The content and schedule for these versions is to be mutually agreed.

k. GSFC shall be responsible for integrating the Level 1a and 1b software at their own site(s).

Beta Version (β) - This version is for the EDC DAAC to assess portability and operability of the science software in the DAAC environment. Programs should be as complete as practical, but should at least reflect an initial assessment of the computation resource consumption of the final version.

Engineering Version (V1) - Programs shall be refinements of the β Version and demonstrate all the major functional capabilities and a complete operator interface, including the generation of all needed messages using standard error and message services.

This version shall require realistic computational resources, near those of version V2.

Launch Version (V2) - This version of the software system shall be launch ready, complete, verified, and operational. Configuration management will be implemented with this version.

Updated Versions - As appropriate to maintain identical configuration to the ERSDAC operational version after the delivery of V2.

It is understood that the ASTER Level 1a and 1b software and documentation will be part of the EOSDIS archive, and will be subject to the EOS Data and Information Policy. In particular, this policy holds that ″EOSDIS will provide the capability for archiving and making available all science data products, models, algorithms, and documentation generated as part of the EOS mission.″ Further, this policy maintains that ″EOSDIS Project Management, in consultation with the IWG, will establish protocols and standards to encourage and facilitate data software exchange and interoperability.″ In this case, this policy is interpreted to mean that ASTER Level 1a and 1b software and documentation may be distributed by EOSDIS on request, subject to any protocols defined by the EOS Investigator Working Group (IWG).

5.1.2 GSFC ASTER Product Generation Software

GSFC, in collaboration with the ASTER Science Team, has the responsibility for generating and maintaining standard ASTER higher-level science data product generation software. In this regard, GSFC, in collaboration with the ASTER Science Team, will prepare an ATBD providing the theoretical basis for standard ASTER Level 2 and higher-level algorithms. This ATBD will be approved by the EOS PSO. GSFC will deliver to ERSDAC standard ASTER Level 2 and higher-level data product generation software. GSFC will define, in collaboration with the ASTER Science Team, additional specific terms for the content and format of the Level 2 and higher-level science software, and the software delivery schedule. The following conditions also apply:

a. GSFC shall provide the standard ASTER higher-level data product generation software and documentation to ERSDAC.

b. GSFC shall provide ERSDAC with standard ASTER Level 2 and higher-level software and documentation upgrades as they become available.

c. GSFC shall be responsible for the development, archive and distribution of ASTER standard Level 2 and higher data products software and for the generation of metadata and browse data.

d. GSFC shall archive correlative or ground-truth observations made in support of ASTER, and shall make these data available to ASTER GDS.

e. GSFC shall provide a software and data management plan that includes enough information to use the software, the specific contents of which are to be mutually agreed.

f. GSFC shall deliver ASTER Level 2 and higher standard data products software as follows: Beta version, Engineering version, Launch version, and Updated versions. The content and schedule for these versions is to be mutually agreed.

g. ERSDAC will be responsible for integrating the Level 2 and higher-level software at their own site(s).

It is understood that EOS product generation software and documentation will be part of the EOSDIS archive, and will be subject to the EOS Data and Information Policy. In particular, this policy holds that ″EOSDIS will provide the capability for archiving and making available all science data products, models, algorithms, and documentation generated as part of the EOS mission.″ Further, this policy maintains that ″EOSDIS Project Management, in consultation with the IWG, will establish protocols and standards to encourage and facilitate data software exchange and interoperability.″ In this case, this policy is interpreted to mean that EOS software and documentation may be distributed by EOSDIS on request, subject to any protocols defined by the EOS IWG.

5.2 IMS SOFTWARE EXCHANGE

GSFC and ERSDAC will establish interoperability between the EOSDIS IMS and the ASTER GDS IMS. The interface between these two systems will be based on the EOSDIS Version 1 IMS design specification, and will evolve with future versions of EOSDIS and the ASTER GDS, as appropriate. In this development, GSFC and ERSDAC will use the Committee on Earth Observations Satellites (CEOS) catalog interoperability model to the extent possible. It is the goal of the GSFC and ERSDAC to develop ″Level 3″ or ″Level-4″ Catalog Interoperability as defined by CEOS.

GSFC will develop and provide documentation for standards for all relevant aspects of the EOSDIS IMS, including EOSDIS internal standards (e.g., catalogs, metadata, browse, data sets, operating systems, and data base management software) and interface standards (e.g., networks, data distribution, and media).

ERSDAC will coordinate the ASTER IMS development with the EOSDIS development to minimize the differences between the EOSDIS IMS and the ASTER GDS IMS, and to facilitate interoperability. ERSDAC will utilize agreed interface standards in the development of the ASTER GDS IMS to support connection of the interoperable interface to EOSDIS.

GSFC and ERSDAC agree to the following conditions for distribution and re-use of EOSDIS IMS software.

5.2.1 EOSDIS IMS Version 0 and Version 1 Client Software (Executable Code)

Executable versions of the IMS Version 0 and Version 1 clients, along with relevant documentation, will be made available to ERSDAC without restriction. It should be noted that the IMS Version 0 is classified by GSFC as an “operational prototype.” As such, GSFC makes no guarantees on the performance of the software and NASA makes no commitment to long-term maintenance or support of the IMS Version 0 software. GSFC may not support the IMS Version 0 software for the life of the EOS-AM1 mission as defined by the MOU.

5.2.2 EOSDIS IMS Version 0 Client Software (Source Code)

Source code for the IMS Version 0 client, along with relevant documentation, will be made available to ERSDAC without restriction. It should be noted that the IMS Version 0 is

classified by GSFC as an “operational prototype.” As such, GSFC makes no guarantees on the performance of the software and GSFC makes no commitment to long-term maintenance or support of the IMS Version 0 software. GSFC may not support the IMS Version 0 software for the life of the EOS-AM1 mission as defined by the MOU.

5.2.3 EOSDIS IMS Version 0 Server Software (Source Code)

EOSDIS Version 0 IMS server software has been provided to NASA’s international partners through the CEOS Catalog Interoperability Experiment (CINTEX). Consequently, GSFC will make the Version 0 IMS server available to ERSDAC for the purpose of prototyping, testing and experimental trials of interagency client-server information management systems. It should be noted that the IMS Version 0 is classified by GSFC as an “operational prototype.” As such, GSFC makes no guarantees on the performance of the software. Also, GSFC makes no commitment to long-term maintenance or support of the IMS Version 0 software; GSFC may not support the IMS Version 0 software for the life of the EOS-AM1 mission as defined by the MOU. Furthermore, GSFC does not guarantee long-term support of IMS Version 1 interoperability with IMS Version 0. Such interoperability may cease along with the termination of GSFC’s support and maintenance of the IMS Version 0. The following conditions apply to exchange of the IMS Version 0 software.

a. GSFC will provide ERSDAC its IMS Version 0 server software (except Commercial Off-the-Shelf (COTS) software) and available documentation.

b. GSFC will make its best effort to maintain, develop, and support continuing engineering of the IMS Version 0 server software in response to recommendations from ERSDAC; however, GSFC is under no obligation to support donated software that has been modified by ERSDAC. As noted above, any support may not extend for the life of the EOS-AM1 mission.

c. GSFC will provide upgrades to the donated software as they become available.

d. ERSDAC will be responsible for the costs of integrating the donated software at their own site(s), and for acquisition, integration and on-site support of any necessary COTS software.

e. ERSDAC may distribute the donated software to its contractors and other users for the purpose of development, integration and testing, but ERSDAC must notify GSFC when it distributes the donated source software and must identify to whom, and for what purpose the donated software was distributed.

f. ERSDAC agrees not to re-distribute modified versions of the donated software without GSFC's written consent.

g. ERSDAC, its contractors and other users must agree not to re-use the donated software in other products without the written consent of GSFC.

5.2.4 EOSDIS IMS Version 1 Server Software

IMS Version 1 server software will not be provided to ERSDAC because this software is site-specific. Although GSFC will not provide IMS server software to ERSDAC, GSFC has no objection if ERSDAC enters into separate negotiations to obtain IMS Version 1 server software from GSFC contractors or other sources.

5.2.5 IMS V0-to-V1 Gateway Software (Source Code)

As noted above, the interface between the EOSDIS and ASTER GDS IMS will be based on the IMS Version 1 design specification. If ERSDAC chooses the IMS Version 0 design specification for its internal standard, an IMS V0-to-V1 gateway will be needed to translate between the IMS Version 0 and IMS Version 1 protocols. GSFC can provide ERSDAC with V0-to-V1 gateway software for this purpose. The operation of such software will require the ERSDAC host computer to support COTS versions of UNIX/POSIX and Distributed Computing Environment (DCE); DCE encryption is required for this interface but only for authentication purposes. It should be noted that GSFC may not support the IMS Version 0 software for the life of the EOS-AM1 mission as defined by the MOU. Thus, GSFC does not guarantee long-term support of the IMS V0-to-V1 gateway software; this support may cease along with the termination of GSFC's support and maintenance of the IMS Version 0. The following conditions also apply to exchange of the IMS V0-to-V1 gateway software.

a. GSFC will provide ERSDAC its IMS V0-to-V1 gateway server software (except COTS software) and available documentation.

b. GSFC will make its best effort to maintain, develop, and support continuing engineering of the IMS V0-to-V1 gateway server software in response to recommendations from ERSDAC; however, GSFC is under no obligation to support donated software that has been modified by ERSDAC and, as noted above, such support may not extend for the life of the EOS-AM1 mission.

c. GSFC will provide upgrades to the donated software as they become available.

d. ERSDAC will be responsible for the costs of integrating the donated software at their own site(s), and for acquisition, integration and on-site support of any necessary COTS software.

e. ERSDAC may distribute the donated software to its contractors and other users for the purpose of development, integration and testing, but ERSDAC must notify GSFC when it distributes the donated software and must identify to whom, and for what purpose the donated software was distributed.

f. ERSDAC agrees not to re-distribute modified versions of the donated software without GSFC's written consent.

g. ERSDAC, its contractors and other users will not re-use the donated software in other products without the written consent of GSFC.

h. GSFC will provide upgrades to the API specifications and corresponding library code for gateway access to the V1 system.

5.3 EOSDIS IST SOFTWARE EXCHANGE

For the purpose of standardizing the EOSDIS planning and scheduling interface, GSFC will make executable versions of the EOSDIS IST software and documentation available to ERSDAC. The EOSDIS IST will be the basis for Japan's ASTER ICC Instrument Operations Team (IOT) personnel to communicate with the EOSDIS EOC for planning and scheduling of the ASTER instrument. All planning and scheduling interfaces between the ASTER IOT personnel and the EOC will be implemented by use of the EOSDIS IST; GSFC and ERSDAC

agree to the following conditions for use and distribution of EOSDIS IST software.

a. GSFC executable versions of the EOSDIS IST, along with relevant documentation, will be made available to ERSDAC.

b. ERSDAC will use the EOSDIS IST to schedule instrument operations commands with the EOSDIS EOC.

c. GSFC will continue to maintain, develop, and conduct continuing engineering of the EOSDIS IST, in response to recommendations from all instrument teams (including ASTER).

d. GSFC will provide ERSDAC with EOSDIS IST upgrades as they become available.

e. ERSDAC may distribute the EOSDIS IST to its contractors and other users for the purpose of integration, testing and operation, but ERSDAC must notify GSFC when it distributes the donated software and must identify to whom, and for what purpose the donated software was distributed.

5.4 ASTER GDS IST

The ASTER GDS IST and the U.S. ASTER IST shall communicate on the ASTER schedule and science-related operations. GSFC and ERSDAC are responsible for the implementation and maintenance of this interface; the Japanese and the U.S. ASTER Science Team members are responsible for the operations of this interface.

5.4.1 ASTER GDS IST Software (Executable Code)

ERSDAC will provide executable versions of the ASTER GDS IST software, software updates, and documentation to GSFC without restriction. The U.S. and Japanese members of the ASTER Science Scheduling Support Group (SSSG) may use the ASTER GDS IST to communicate on relevant aspects of the ASTER schedule.

5.4.2 ASTER GDS IST Software (Source Code)

ERSDAC will provide the ASTER GDS IST source code to GSFC subject to the following conditions:

a. Software Design and manual will be provided in Japanese.

b. If the receiver of the IST software modifies it, the donor will not be responsible for the software.

c. The IST software should not be transferred by the receiver to a third party without permission of the donor.

d. Display in English.

5.5 SCIENCE DATA PROCESSING TOOLKIT

The EOSDIS SDP Toolkit is designed to be used for data production software development, testing and integration, and for operations in Science Computing Facilities. GSFC will provide the SDP Toolkit (source code)to ERSDAC subject to the following conditions.

a. GSFC will provide the SDP Toolkit and documentation (except for COTS software and documentation) to ERSDAC.

b. GSFC will make its best effort to maintain, develop, and support continuing engineering of the SDP Toolkit in response to recommendations from ERSDAC; however, GSFC is under no obligation to support SDP Toolkit software that has been modified by ERSDAC.

c. GSFC will provide upgrades to the SDP Toolkit as they become available.

d. ERSDAC will be responsible for the costs of integrating the SDP Toolkit at their own site(s), and for acquisition, integration and on-site support of any necessary COTS software.

e. ERSDAC may distribute the SDP Toolkit to its contractors and users for the purpose of ASTER science data product generation, integration and testing, but such re-distribution must be made free of charge to the end user.

f. ERSDAC must notify GSFC when it distributes the SDP Toolkit, and must identify to whom, and for what purpose the donated software was distributed.

g. ERSDAC agrees not to re-distribute modified versions of the SDP Toolkit without GSFC’s written consent.

h. ERSDAC, its contractors and users will not re-use the SDP Toolkit in other products without the written consent of GSFC.

5.6 ASTER GDS DAR CLIENT SOFTWARE (SOURCE CODE)

The ASTER GDS DAR client component provides a common set of functions for the ASTER Science Team and for other authorized ASTER GDS and EOSDIS users. Overall, these functions include DAR generation, limit check, display of XAR status, status checks, mission schedule, XAR database queries, etc., although the allocation of these functions to users depends on user authentication and user privileges. The EOSDIS DAR client, which is based on the ASTER DAR client, permits authenticated users to access these services via interaction with the ASTER GDS XAR Server via a single physical interface using an ASTER GDS-defined protocol. An ASTER GDS-defined API provides a well-defined interface between the ASTER GDS DAR client Graphical User Interface (GUI) layer and the client's application code layer. ERSDAC will provide the ASTER GDS DAR client, the client functionality software components, and the communications layer interface software to GSFC subject to the following conditions.

a. ERSDAC has the following responsibility on software delivery:
The DAR Client Toolkit will execute correctly in the GDS environment. ERSDAC will provide the newest version to EOSDIS when a new release is issued for ASTER GDS. ERSDAC will give answers to design and implementation questions from NASA on a best efforts basis, but it has no responsibility for installation of the software to the EOSDIS environment, and no responsibility for maintenance of installed software in EOSDIS. For the GUI part, ERSDAC will provide the latest version to EOSDIS, but it has no responsibility for it.

b. ERSDAC has the following responsibility on DAR client software document preparation:
For the DAR Client Toolkit, minimum documentation necessary to use the toolkit will be prepared in English. Other documents will be provided in Japanese if requested. For the GUI part, documents will be provided in Japanese if requested.

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6. OPERATIONS CONCEPTS

6.1 ASTER FLIGHT OPERATIONS

MITI has the primary responsibility for operating the ASTER instrument; NASA has the responsibility for the EOS-AM1 spacecraft. The ASTER Science Team and ERSDAC's ASTER Ground Data System Project will collaborate on planning and scheduling of the ASTER instrument. Operation of the EOS-AM1 spacecraft and the ASTER instrument will be managed principally through the functions provided by the EOSDIS EOC and the ASTER ICC. These operations are intended to conform to controlling documents and to be consistent with applicable documents listed in Section 7.

The EOC is the conduit for all commands for the EOS-AM1 spacecraft; however, the EOS-AM1 spacecraft schedule will be a coordinated effort between the EOC and the ASTER ICC. The ASTER ICC will generate schedules and transmit them to the EOC after checking the instrument operation constraints and resource constraints allocated by the spacecraft. The EOC will accommodate the ASTER schedule unless constraints are violated or resources are not available. The EOC will notify the ASTER ICC of any problem and the ASTER ICC will modify their requests to resolve the problem.

The EOC may generate "safing" commands for the ASTER instrument. These are defined as EOC-generated commands defined by the OICD and are used in the event that a hazard is detected by the EOC or when communications with the ASTER ICC are lost and a problem exists. The EOC will use GSFC-generated software to conduct basic health and safety checking of the ASTER instrument. Checking will be based on instrument range specifications provided by the JAROS.

The ASTER ICC will have access to EOC plans and schedules, including information on spacecraft subsystem operations, other instrument operations, predicted orbit data, and space/ground communications schedules. The ASTER ICC and the EOC will exchange operations information such as reports, spacecraft/instrument status, and spacecraft/instrument parameter information.

6.2 DIRECT ACCESS SYSTEM OF EOS-AM1

EOS-AM1 has a direct access system that provides three x-band data transmission services for transmitting data to the ground: Direct Broadcast (DB), Direct Down Link (DDL), and Direct Playback (DP). The DB service provides a continuous broadcast of real time Moderate

Resolution Imaging Spectroradiometer (MODIS) data. The DDL service provides a pre-scheduled transmission of real time ASTER data to Japan. Sites other than Japan or the U.S. must be mutually agreed and documented in this PIP. The DP service is reserved for the EOS AM Project and will be used by the EOS AM Project only when the normal data transmission via TDRSS is not available.

6.2.1 Direct Down Link

The DDL service provides a pre-scheduled transmission of real time ASTER data. DDL data will only be transmitted during short contact periods when the spacecraft is within view of selected user ground station(s) and ASTER is gathering science data. The data which comes down through the DDL will simultaneously be recorded onboard the spacecraft. It will then be processed as part of the normal ASTER data stream.

The locations of ground stations will be provided by ERSDAC. Scheduling DDL service will be part of the planning and scheduling process between the EOC and the ASTER ICC. Specifications of the DDL technical characteristics are in document “Direct Access System (DAS) User’s Guide.”

6.3 ASTER SCIENCE AND ENGINEERING DATA PROCESSING

GSFC constructs ASTER Level-0 data sets from the raw data stream. Level-0 data will be available for postal pickup at the average rate of all incoming spacecraft data, with backlogs cleared within 48 hours 99% of the time.

The Japan ASTER PGS will process all of the ASTER Level-0 data to Level-1a. All level-1a products, metadata, and browse files will be available for postal pickup at the ASTER DADS, on average within 24 hours following the receipt and ingest of corresponding Level-0 data at the Japan ASTER PGS.

ERSDAC will determine the content and format of the Level 1 browse file in consultation with the ASTER Science Team. This format will be compatible with the browse standards defined by GSFC. All telescopes (VNIR/SWIR/TIR) will have Level 1a browse data generated from 1 or more bands. Only postal delivery of browse data to EOSDIS is planned.

EOS standard data products are defined in the ”ASTER Science Standard Data Product Specification” document, prepared by the ASTER Science Team; are evaluated and endorsed by the EOS IWG; and

are approved by the EOS Program and Project Scientists. These include the Level 1a product, the Level 1b product, and Level 2 and higher-level products.

The ASTER SDPS will process all of the ASTER Level 0 data to Level 1a. All Level-1a products, metadata, and browse files will be available for postal pickup at the ASTER SDPS within an average of 24 hours following the receipt and ingest of corresponding Level 0 data at the ASTER SDPS. The ASTER SDPS will generate standard EOS ASTER data products: Level-1a, Level-1b, and Level-2 and higher (if any).

The quantity of Level-1b data generated by the ASTER GDS is limited to 310 scenes per day. Following processing, Level-1b data will be delivered to ECS. Requests for data products in excess of the 310 scene limit will be honored if and when processing capacity becomes available at the SDPS. Priorities for effective use of the ASTER SDPS processing capacity will be set in consultation with the ASTER Science Team. The ASTER SDPS will provide the ECS SDPS with a Data Availability Schedule which will specify the expected delivery schedule for ASTER GDS products.

ERSDAC will make EOS standard products available in EOSDIS-defined standards; specific formats and system performance specifications are to be jointly agreed and documented in ICDs.

In the U.S., metadata for higher-level products (including browse) will be generated by the EDC DAAC and will be made available to Japan on request. In Japan, metadata for higher-level products (including browse) will be generated by the Japan ASTER SDPS and will be made available to the U.S. on request.

Requests for expedited data service (EDS) will be compiled at ASTER GDS and identified at the ASTER GDS ICC by a Quick Look Flag in the schedule sent to the EOSDIS EOC. EDS data requested by ERSDAC (up to 2 scenes/day) will be obtained from the U.S. via electronic networks.

As for spacecraft and ASTER instrument housekeeping data, all real time telemetry from the spacecraft and ASTER instrument will be transmitted to Japan via electronic networks during each TDRSS contact. A complete set of housekeeping data will also be made available for postal pickup by Japan as part of the Level-0 data set.

6.4 ASTER INSTRUMENT ACTIVITY REQUESTS

The ASTER instrument will primarily rely on ASTER Instrument Activity Requests (XARs) for its operations. A XAR can be defined as a user request for future data acquisition by ASTER. There are several types of instrument activity requests:

Data Acquisition Request (DAR)	Approved investigator request for instrument activity relating to data acquisitions.
Target of Opportunity (TOO)	Special case of DAR in which there is an urgency to the request (a short lead time, an unexpected event, etc.)
Science Team Acquisition Request (STAR)	Large scale or common areas for acquisitions are requested by the Science Team on behalf of Investigators
Engineering Team Request (ETR)	Used by the Instrument Engineering Team to request instrument activities for purposes of instrument calibration, health and safety.

At launch, there will be a list of acquisition targets for ASTER that conforms to guidelines provided by the ASTER MOU and the EOS IWG, and that has been previously agreed to by the EOS Project Scientist and the ASTER Science Team. Additions and changes to this list will occur via XARs, which will be submitted to the ASTER ICC. The ASTER ICC, under the guidance of the ASTER Science Team Leader, will accept or deny the XARs based on guidelines and priorities defined in the ASTER MOU, by the EOS Project Scientist, by the EOS IWG, and by the ASTER Science Team. Accepted XARs will be added to the acquisition target list. The ASTER ICC will provide XARs status to users via the IMS, identifying specific XARs as accepted, scheduled, deleted, satisfied, rescheduled, and so on.

Periodically, or at the recommendation of the IWG or the ASTER Science Team, the EOS AM Project Scientist or his designee may go through the target list and remove XARs that no longer meet the evolving EOS science goals, or that are of such low priority that their probability of being scheduled is low or none. Assessment of XARs priority will be based on a combination of several factors

including the requester's priority and the relevance of the science goals for the acquisition.

A special subset of XARs are termed Targets of Opportunity (TOO). A TOO is a DAR that requires some form of special handling, such as scheduling in a time frame shorter than that normally planned. As with DARs, TOOs are submitted through an IMS. The ICC will attempt to schedule a TOO based on guidelines for such requests. If the ICC is unable to schedule the TOO, the ICC will request resolution by the Team Leader through the SSSG. If the SSSG has any irreconcilable schedule conflicts, the SSSG will request resolution by the AM Project Scientist.

The EOS AM Project Scientist or his designee will be capable of reviewing XARs and schedules to verify that the ASTER XAR scheduling process is meeting science goals. The ASTER ICC will have a mechanism to generate statistics that show how well the XAR schedule has satisfied guidelines and priorities.

6.5 ASTER DATA PRODUCT REQUEST

In general, each side is responsible for the cost of transmission (media and shipping or communication) for data it requests. Each side pays for the processing it undertakes as a responsibility in the MOU. In other words, only the cost of postage and physical media (e.g., tapes) are charged when data are exchanged between EOSDIS and the ASTER GDS.

In the case of user requests (other than NASA) to the ASTER GDS for ASTER data, the cost of fulfilling the user request (COFUR) will include postage and the costs of the physical data transfer medium if the data are delivered via the mail. If data are delivered via science networks, the non-recurring costs of data transfer (if any) will be borne by the user. If the data set must be generated from lower-level data, then the non-recurring costs for product generation may also be added to the COFUR charged to the user. Therefore, in particular,

- GSFC pays for the cost of Level 0 processing, ERSDAC pays for the cost of getting the Level 0 data set back to Japan.

- ERSDAC pays for the complete Level 1a processing, and for any Level 1b processing requested by GSFC. GSFC pays for getting the Level 1a and requested Level 1b data back to the U.S.

- If users other than NASA ask for Level 1b data from ERSDAC, ERSDAC may charge the cost of filling the user request. If the data have already been processed and are available in Level 1b form, the user would pay only the data reproduction and shipping or electronic communication costs. If the data have to be processed specially for the user, the user could be charged the incremental processing costs.

- With regard to GSFC and ERSDAC requests for Level 2 and higher-level data, the requesting agency pays for the data transmission costs as explained in above bullet. If the data request requires the product to be generated from lower-level data, the providing agency may charge the marginal costs for product generation. If the requested data already exists in the archive, only the data reproduction/shipping or electronic transmission costs are charged.

It is recognized that the actual costs will depend on data volume, formatting, and other factors and that the details of a cost algorithm will be agreed at the program level by MITI and NASA Headquarters.

6.6 PRE-LAUNCH ACTIVITIES/INTERFACES

6.6.1 Integration and Testing

System integration between the ASTER GDS and EOSDIS is conducted in a series of phased, incremental tests, which ERSDAC and ESDIS shall agree to and document in the “ASTER GDS/EGS Integration Test Agreement.” These tests are intended to exercise system components, and to confirm that relevant interfaces and end-to-end system performance meet mission requirements.

ASTER EGS/GDS Integrated Test Schedule. The schedule for interface testing and related ASTER GDS-to-EGS joint pre-mission events will be mutually agreed and documented in the “ASTER GDS/EGS Integrated Test Schedule.” The Test Schedule will be maintained by the ESDIS Project and will be updated based on mutual agreement; with due consideration given to joint development schedules, test goals, mission-driven readiness and reviews.

Joint EGS Test Plans. Detailed descriptions of the scenarios, objectives, and system resource requirements described in the joint ASTER GDS/EGS Test Schedule will be documented in the “EGS Integration and Test Plan” for EOSDIS Versions 1 and 2.

In addition to the I&T activities described above, both parties will participate, as appropriate, in the integration and test activities that are planned by the EOS-AM Project, as documented in the EOS-AM1 Integration and Test Plan provided by the spacecraft developer.

Finally, informal tests/data flows between relevant elements of the ASTER GDS and EOSDIS will be conducted, as needed, prior to the formally scheduled activities to verify readiness of both parties.

6.6.2 Mission Operations Readiness

Prior to launch, both parties will develop operations procedures that deal with the interfaces between the ASTER GDS and EOSDIS. Procedures development will start at approximately launch minus 24 months. These procedures include those for the contingency monitoring at the EOC of the ASTER instrument health and safety (this function is nominally done at the ASTER ICC), and the procedures to be followed in case of a spacecraft onboard anomaly.

In addition to the test activities at the launch site, both parties will support as needed, ground system mission operations simulations and operations readiness exercises that will be conducted during the three months prior to launch.

6.6.3 Training

As mutually agreed, the ERSDAC will provide training to EOSDIS flight operations personnel on the health and safety monitoring and control of the ASTER instrument. This training will include ASTER critical contingency operations at the EOC as well as the nominal operations with the ASTER Instrument Control Center (ICC).

As mutually agreed, GSFC will familiarize ASTER GDS flight operational personnel on the operation of the EOC.

6.7 ASTER POST-LAUNCH ACTIVATION

Following the EOS AM1 Spacecraft launch and prior to commissioning the instruments for inflight investigative use, a checkout period is planned that will involve the systematic verification of each instrument's end-to-end performance. The ASTER activation and evaluation phase should not exceed 90 days. During this phase, the ASTER data will be made available to the ASTER GDS and the

ASTER Science Teams for evaluation. This data will be used solely for the purpose of determining operational readiness. No scientific use of ASTER data will be made until after the operational phase begins, when the data is made available to all approved users as per the EOS Data Policy.

Procedures for activating and operating the instrument during the activation phase will be well established before launch. These procedures will be agreed upon by both parties and documented.

During this period, the ASTER ICC is responsible for assessing the instrument's engineering performance by evaluating ASTER telemetry. The EOC will check health and safety data and respond in accordance with established procedures. The EOC will provide normal operational functions, such as command uploads, health and safety telemetry monitoring, as well as arranging any required and agreed to extra TDRSS sessions. The ASTER Integrated Ground System, both U.S. and Japanese elements, is responsible for processing data in the timeliness of the normal operating mode to enable the Science Team (both Japanese and U.S. members) to evaluate the instrument radiometric performance and quality of the data being produced as standard data products. ERSDAC, JAROS and the ASTER Science Team are responsible for determining readiness to transition to the operational phase.

ERSDAC and/or JAROS shall support instrument activation by having a representative(s) reside at the EOC or other locations, as required and mutually agreed, during this phase.

The activation phase goals for the ASTER are to:

a. verify that instrument subsystem engineering performance is consistent with test results, including the trend analyses, obtained during instrument integration and test.

b. verify that the ASTER Integrated Ground System, including both U.S. and Japanese elements, processes ASTER flight data and generates ASTER standard data products in accordance with pre-launch operational plans and procedures.

c. perform the initial inflight calibration of the VNIR, SWIR, and TIR, and verify that standard products produced by these units yield results consistent with predicted radiometric performances.

6.8 ASTER OPERATIONAL SCENARIO

ASTER operational scenario parameters are to be discussed in, and requested by, the ASTER Science Team. The total end-to-end system must be designed to handle the worst credible case, even though they occur infrequently. These worst cases quantify maximum limits of operational parameters. Both parties should pay prudent attention to the ASTER Science Team Request. Also, both parties should take good care of the newest results, such as number of observations, number of cross-track pointing slews, observation durations, resource allocations, and related items from the AST.

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7. DOCUMENTATION

The ASTER MOU is the parent document from which the PIP Volume 2 derives its scope and content. In case of conflict with the documents listed below, the MOU shall have precedence. The full title of the ASTER MOU is “Memorandum of Understanding between the United States National Aeronautics and Space Administration and the Ministry of International Trade and Industry of Japan concerning Cooperation in the Flight of the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) on the NASA Polar Orbiting Platform and Related Support for an International Earth Observing System.” The ASTER MOU was signed (date TBD).

7.1 APPLICABLE DOCUMENTS

Documents applicable, either in entirety or in part, to the on-orbit operation of the ASTER instrument and to the ground data processing of ASTER data are herein listed. The latest version of the document is considered applicable for the purpose of this PIP.

7.1.1 Documentation Applicable in Entirety

The following documents contain details of the system interfaces between GSFC and ERSDAC and are applicable in their entirety.

GSFC Documents

a. EOSDIS Core System Project, Interface Requirements Document Between EOSDIS Core System and MITI (ASTER), 194-219-SE1-002.

b. Interface Control Document Between EOSDIS Core System and the MITI ASTER GDS.

c. Proposed ECS Core Metadata Standard, Release 2.0, Doc. #420-TP-001-005.

d. HDF-EOS Primer for Version 1 EOSDIS; White Paper; Brand Fortner and Doug Ilg; 4/10/95, Doc. #175-WP-001-001.

e. Interface Control Document Between the Earth Observing System (EOS) Data and Operations System (EDOS) and the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Ground Data System (GDS).

f. Operations Agreement Between the Earth Observing System (EOS) Data and Operations System (EDOS) and the MITI Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Ground Data System (GDS).

g. Interface Control Document Between EBnet and the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Ground Data System (GDS).

h. Interface Control Drawing, Operations, EOS AM Spacecraft to the ASTER.

i. Interface Control Drawing, Command and Telemetry, EOS AM Spacecraft to ASTER.

j. ASTER EGS/GDS Integrated Test Schedule.

k. ASTER EGS/GDS Integration Test Agreement.

ERSDAC/JAROS Documents

l. ASTER Checkout Procedures (Checkout Specifications, Checkout Procedures, Verification Procedures).

m. ASTER Operation Procedure (Command Sending Procedures, Telemetry Checking Procedure).

n. ASTER Mission Operation Procedure.

o. Interface Control Document for the ASTER IST Between ASTER GDS and the ASTER Science Team.

7.1.2 Documentation Applicable in Part

The following documents address programmatic and technical matters mutually important to both parties in the planning and implementation of the ASTER operations and ground data processing systems. Only those portions of these documents addressing programmatic and technical matters in a manner consistent with the terms and conditions of the MOU are considered applicable.

a. ECS Product Generation System (PGS) Toolkit Requirements Specification, Document No. 423-16-02.

b. Data Format Control Document for the Earth Observing System (EOS) AM-1 Project Data Base, Doc. No. 209-CD-004-001.

c. Data Production Software and Science Computing Facility (SCF) Standards and Guidelines, Doc. No. GSFC-423-16-01.

d. Interface Requirements Document for EBnet.

e. Ground System Integration and Test Plan, ESDIS (TBD).

f. Interface Requirements Document for the ASTER IST Between ASTER GDS and the ASTER Science Team.

g. EOS Configuration Management Plan 420-02-02.

h. DAS User’s Guide.

7.2 REFERENCE AND INFORMATION DOCUMENTS

The following documents contain information and reference material relevant to this PIP. In the event of conflict between any of these documents and the PIP, the PIP shall take precedence.

a. ECS IST Capabilities Document.

b. Interface Control Document Between ECS and Science Computing Facilities, GSFC-209-CD-005-001.

c. PGS Toolkit Requirements Specification for the ECS Project, GSFC-423-16-02.

d. PGS Toolkit Users Guide for the ECS Project, 194-809-SD4-001.

e. Science Users Guide and Operations Procedure Handbook for the ECS Project, 193-205-SE1-001.

f. ECS Operations Concept Document for the ECS Project, 193-604-OP1-001.

g. CEOS Guidelines Document.

h. ASTER Operational Handbook, ERSDAC.

i. Function Requirements for Mission Operations, ASTER Science Team.

j. The EGS Integration and Test Plan for Version 1 (initial AM-1 interface testing), March 1996.

k. The EGS Integration and Test Plan for Version 2 (validation of interfaces for mission operations support), 1997.

7.3 DOCUMENTATION DELIVERABLE REQUIREMENTS

Documents that contain required information for both sides will be exchanged as mutually required and agreed.

7.4 CHANGE CONTROL PROCEDURE

Changes proposed by either party to applicable documents under configuration control are to be negotiated, mutually agreed, and processed in accordance with the Configuration Management Plan of the document-controlling party. Agreed upon changes will be implemented by the document-controlling party.

APPENDIX A

Glossary of Acronyms

Glossary of Acronyms

ADN	ASTER Data Network
AOS	ASTER Operation Segment
API	Applications Program Interfaces
AST	ASTER Science Team
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
ATBD	Algorithm Theoretical Basis Document
CCB	Change Control Board
CEOS	Committee on Earth Observations Satellites
CINTEX	CEOS Catalog Interoperability Experiment
CM	Configuration Management
COFUR	Cost of Fulfilling User Request
COTS	Commercial Off-the-Shelf
CSMS	Communications and System Management Segment
DAAC	Distributed Active Archive Center
DADS	Data Archive and Distribution System
DAR	Data Acquisition Request
DAS	Data Access System, Data Analysis Subsystem, Direct Access System
DB	Direct Broadcast
DCE	Distributed Computing Environment
DDL	Direct Down Link
DP	Direct Playback
DPS	Data Processing Subsystem
DRS	Direct Receiving Subsystem
DSN	Deep Space Network
EBnet	EOSDIS Backbone Network
Ecom	EOS Communications Network
ECS	EOS Core System
EDS	Expedited Data Service
EDOS	EOS Data and Operations System
EGS	EOS Ground System
EOC	EOS Operations Center
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
ERSDAC	Earth Remote Sensing Data Resources Analysis Center
ESDIS	Earth Science Data and Information System
ETR	Engineering Team Request
FOS	Flight Operations Segment

GDS	Ground Data System
GSFC	Goddard Space Flight Center
GSMS	Ground System Management Subsystem
ICC	Instrument Control Center
IGS	Integrated Ground System
IMS	Information Management System
IOT	Instrument Operations Team
IST	Instrument Support Terminal
IWG	Investigator Working Group
JAROS	Japan Resources Observation System Organization
MITI	Ministry of International Trade and Industry
MODIS	Moderate Resolution Imaging Spectroradiometer
MOU	Memorandum of Understanding
MTPE	Mission to Planet Earth
MTTRS	Mean Time to Restore Service
MUX	Multiplexer
NASA	National Aeronautics and Space Administration
NCC	Network Control Center
NSI	NASA Science Internet
ODCs	Other Data Centers
OICD	Operations Interface Control Drawing
PGS	Product Generation System
PIP	Project Implementation Plan
POSIX	Portable Operating System Interface
PSO	Project Science Office
SCF	Scientific Computing Facilities
SDPS	Science Data Processing Segment
SID	Space Industry Division
SISS	Software Implementation Support Subsystem
SMC	System Monitoring and Coordination
SSSG	Science Scheduling Support Group
STAR	Science Team Acquisition Request
SWIR	Short Wave Infrared Radiometer
TDRSS	Tracking and Data Relay Satellite System
TIR	Thermal Infrared Radiometer
TOO	Target of Opportunity
U.S.	United States

VNIR	Visible and Near Infrared Radiometer
XAR	ASTER Instrument Activity Requests